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Stress-Corrosion-Induced Property Changes in Aluminum Alloys

The development of high strength aluminum alloys for use in the aerospace industry has improved strength to weight ratios significantly. Many of these alloys, however, are highly susceptible to stress-corrosion cracking. The fundamental mechanisms of stress corrosion on a microscopic basis are not well understood, and no method is available today for determining stress corrosion "damage" prior to failure.

An investigation was conducted to provide a better understanding of stress-corrosion mechanisms, to determine rapid, practical means of evaluating stress-corrosion susceptibility, and to measure stress-corrosion-related material property changes nondestructively. Measurements of electrical conductivity, ultrasonic surface wave attenuation, and internal friction loss were made on aluminum alloys 7079-T6, 2219-T31, and 2219-T81 as a function of the onset of stress corrosion. The results of these measurements are summarized below.

The magnitude of electrical conductivity values, ultrasonic surface wave attenuation, and internal friction loss is changed by the stress corrosion of 7079-T6 aluminum. Stress corrosion also causes a rapid decrease in the electrical conductivity of 2219-T31 aluminum. Corrosion only, has much less effect on this alloy. Thus, a nondestructive testing potential exists for 7079-T6 and 2219-T31 aluminum alloys.

No significant difference was observed in the electrical conductivity of 2219-T81 specimens exposed to stress corrosion and those exposed to corrosion only. This is as expected, since 2219-T81 material is not susceptible to stress-corrosion cracking. Both stress corrosion and corrosion alone cause rapid attenuation of ultrasonic surface waves in 2219-T31 and 2219-T81 aluminum alloys.

Low frequency internal friction measurements appear to be useful only as a means of studying stress corrosion mechanisms in the laboratory. It is doubtful that this particular method could presently be adapted to the practical evaluation of degraded materials in actual components.

The eddy current or conductivity method appears to be superior to the ultrasonic method of measuring stress-corrossion damage in certain aluminum alloys. The coupling of energy into the material is easier to effect with the conductivity method. However, more work is required to determine the full applicability and limitations of each method.

Note:

Documentation is available from:
Clearinghouse for Federal Scientific and Technical Information
Springfield, Virginia 22151
Price $3.00
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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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